

Catheter Infections



EVIDENCE AND RECOMMENDATIONS

- Hospital Infection Control Practices Advisory Committee (HICPAC)
 - Guidelines for the prevention of Intravascular device-related infection. MMWR 2002 51:1-29
 - >100 Recommendations
- Evidence-based guidelines for prevention of healthcare-associated infection (EPIC-2)
 - Guidelines for preventing infections associated with the use of central venous access devices. J Hosp Infect 2007 S33-S49
 - 47 Recommendations
 - **“Saving Lives” bundles - (High Impact Interventions)**
 1. Central venous catheter care bundle
 2. Peripheral intravenous catheter care bundle
 3. Renal dialysis catheter care bundle
- Society for Healthcare Epidemiology of America/Infectious Diseases Society of America SHEA/IDSA
 - Strategies to prevent central line-associated bloodstream infections in acute care hospitals Infect Control Hosp Epidemiol 2008 29:S22-S30
 - 34 Recommendations (+7 others)

CATHETERS - AN INDISPENSABLE PART OF PATIENT CARE MONITORING AND INFUSION

Peripheral venous	Arms, feet
Peripheral arterial lines	Arms, feet, groin
Central venous catheters (CVC)	Neck, infra-clavicular, groin
Peripherally inserted central (PICC)	Arms
Tunnelled, cuffed (Hickman)	Chest wall

US - 3 million CVCs a year

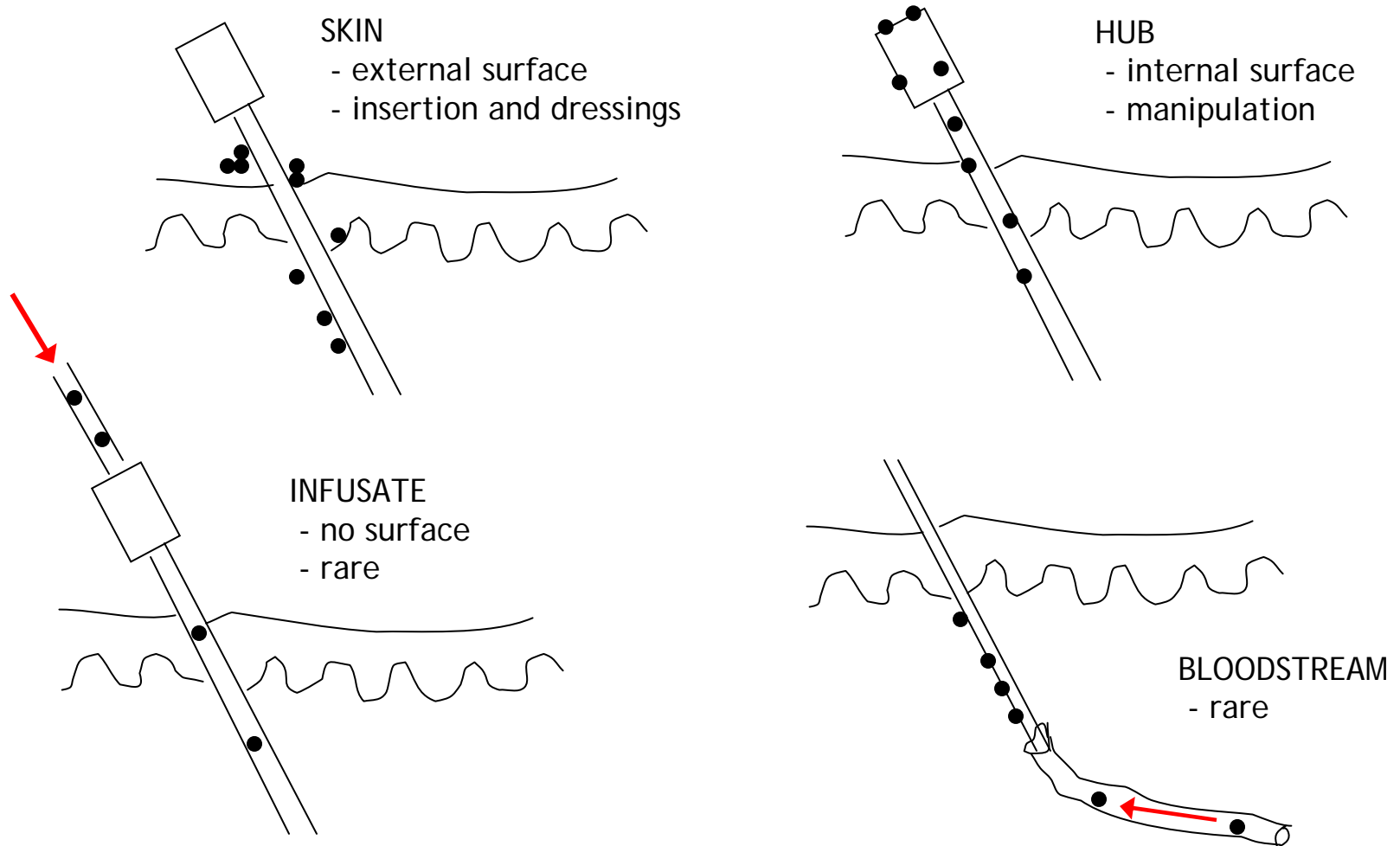
UK - 240,000 CVCs a year

..... and catheters cause infections

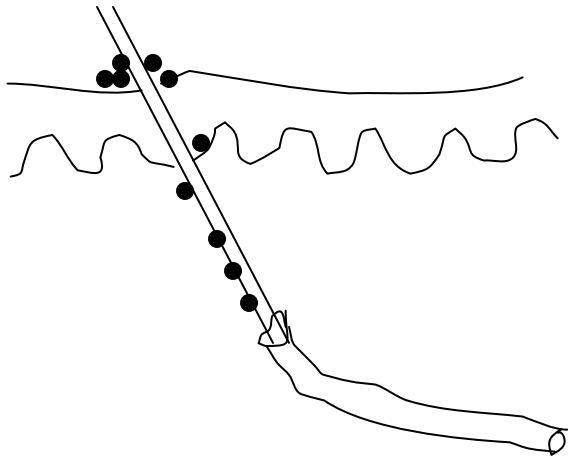
CATHETER INFECTIONS - SURVEILLANCE AND CLINICAL DEFINITIONS

- Local, blood stream and metastatic infections
- Catheter-associated blood stream infection (/1000 catheter days)
 - BSI with a catheter in place when other sites excluded
- Catheter-related blood stream infection (CRBSI) (/1000 catheter days)
 - Bacteria isolated from blood
 - Clinical and laboratory indicators of infection
 - No other apparent source
 - Positive culture of catheter with same organism

PATHOGENESIS



LOCAL INFECTION



An underappreciated cause of sepsis?

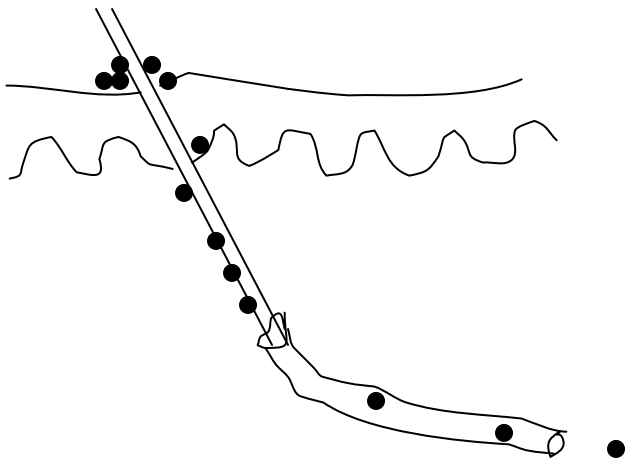
Organisms most frequently colonising catheters and the predicted risk of CRBSI

(9272 admissions to general ICU 1986-1995)

	No. Catheters	No. CRBSI	Risk (%)
CNS†	1579	31	2
Enterococcus	312	18	6
S. aureus	159	31	19
Pseudomonas	158	42	27
Candida	157	15	10
Enterobacter	97	11	11
Klebsiella	82	19	23
Proteus	69	5	7
E. Coli	54	3	6

† Coagulase-negative staphylococci

CATHETER-RELATED BLOOD STREAM INFECTION (CRBSI)



Healthcare (ICU)-associated BSI

Study (no. of BSI)	Primary (NK)	Secondary	CRBSI
1 (104)	21	60	19
2 (111)	27	38	35
3 (329)	22	16	62
4 (111)	29	45	26
5 (105)†	61	18	21
Total 760	30% (22-61)	29% (16-60)	41% (19-62)

† ICU and surgical wards

1. Pittet et al JAMA 1994 271:1598
2. Rello et al Intensive Care Med 1994 29:94
3. Edgeworth et al Crit Care Med 1999 27:1421
4. Renaud et al Am J Respir Crit Care Med 2001 163:1584
5. Orsi et al Infect Control Hosp Epidemiol 2002 23:190

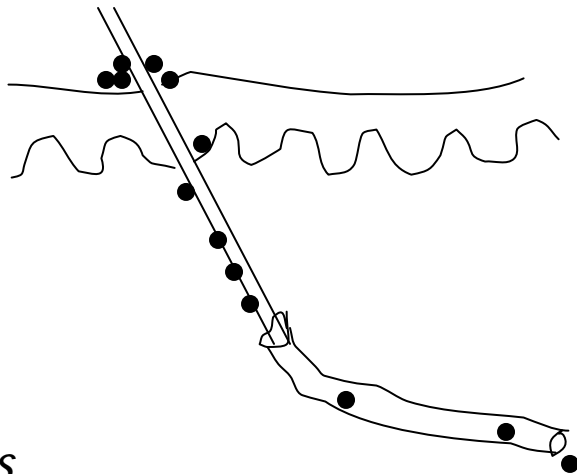
DIAGNOSIS OF CRBSI

- Semi-quantitative (>15 CFU/catheter tip)
- Quantitative (>10³/catheter tip)
- Simultaneous quantitative [catheter:peripheral 5:1]
- Time to positivity [catheter-peripheral >2 hours]
 - All tests have acceptable sensitivity and specificity (>0.8) and negative predictive value (>99%)
 - Positive predictive value increases greatly with pre-test clinical probability

INCIDENCE RATES OF CRBSI FOR DIFFERENT CATHETERS

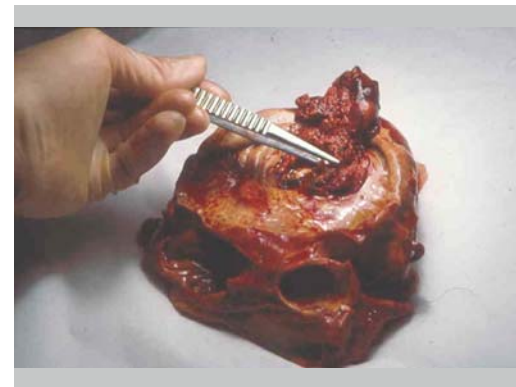
	Number of Catheters	Catheter days	Rate/1000 Catheter days
Peripheral venous	10,910	28,720	0.5 (0.2-0.7)
Outpatient PICC	2,813	98,702	1.0 (0.8-1.2)
Tunneled venous	4,512	622,535	1.6 (1.5-1.7)
Arterial Catheters	4,366	21,937	1.7 (1.2-2.3)
Inpatient PICC	625	7,137	2.1 (1.0-3.2)
Short term Central venous	20,226	322,283	2.7 (2.6-2.9)

METASTATIC INFECTION



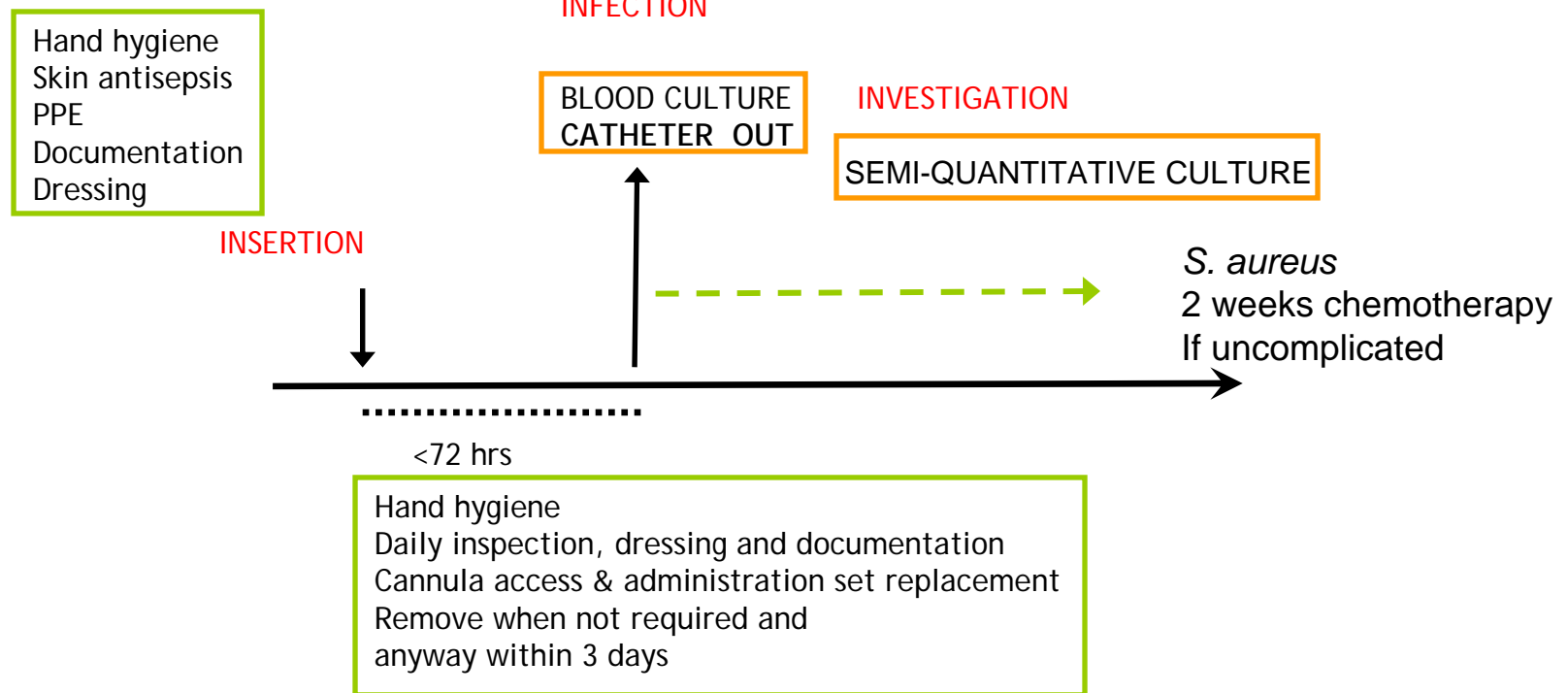
S. aureus
Candida

Less than 5% of CRBSI cause metastatic focus



PREVENTION AND DIAGNOSIS OF CRBSI

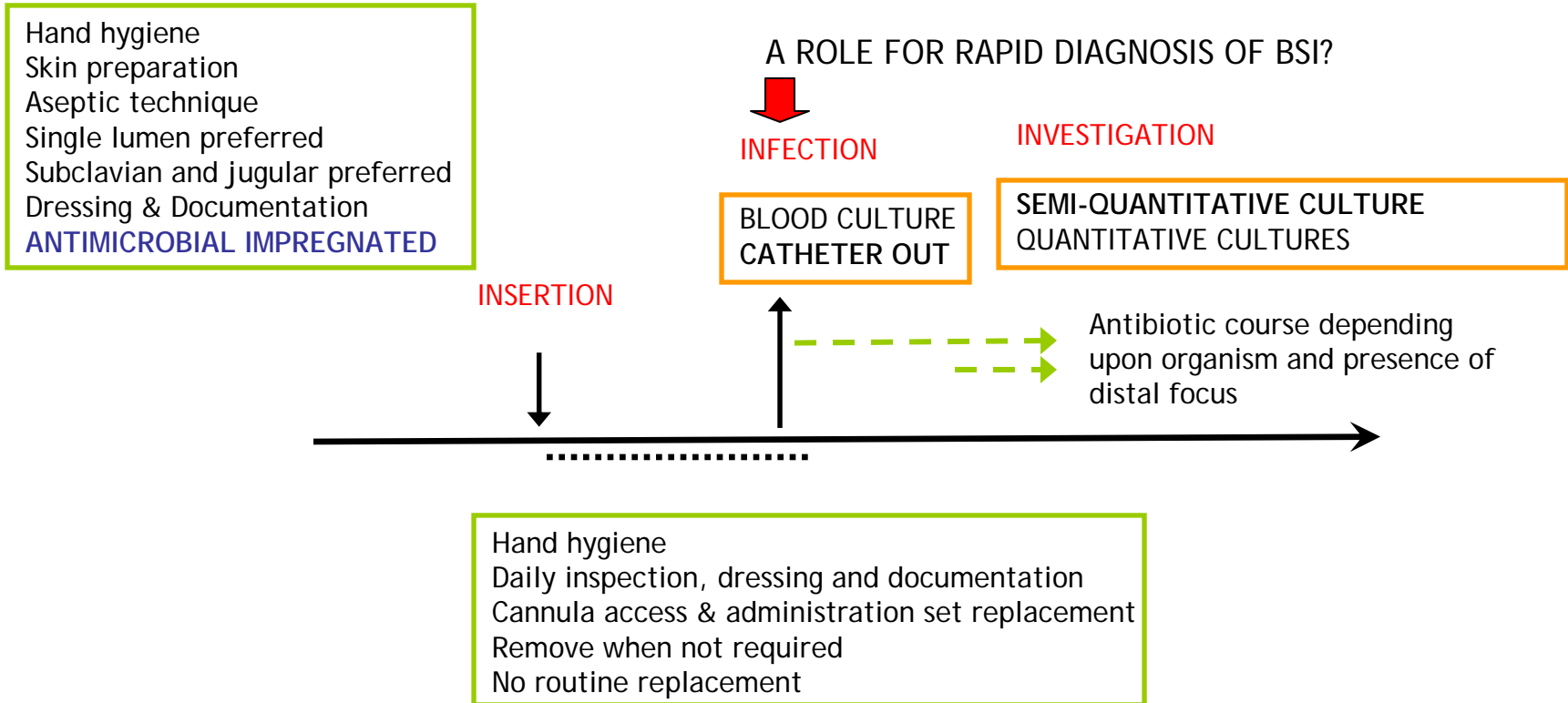
PERIPHERAL CATHETERS



BOARD TO FLOOR ACCOUNTABILITY, EDUCATION, SURVEILLANCE AND FEEDBACK

PREVENTION AND DIAGNOSIS OF CRBSI

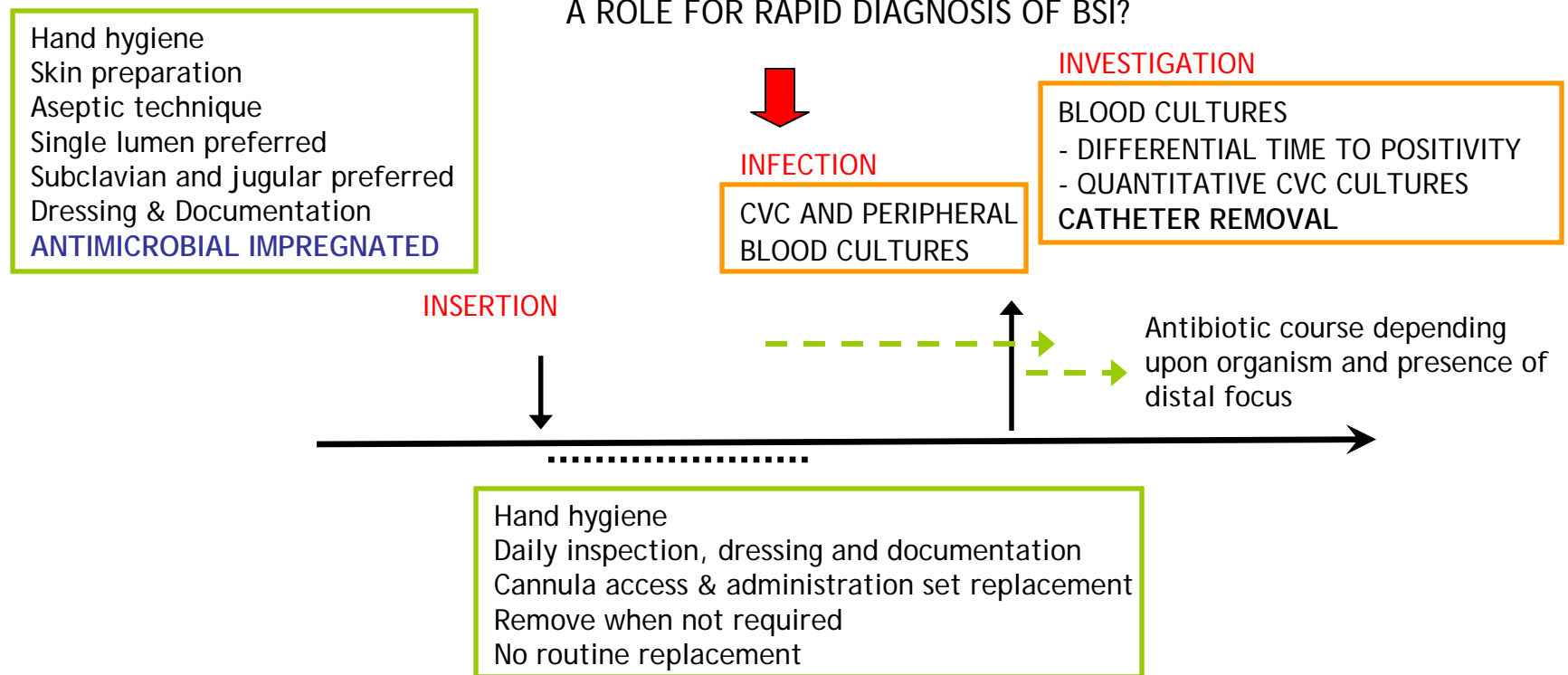
SHORT TERM CENTRAL VENOUS CATHETERS



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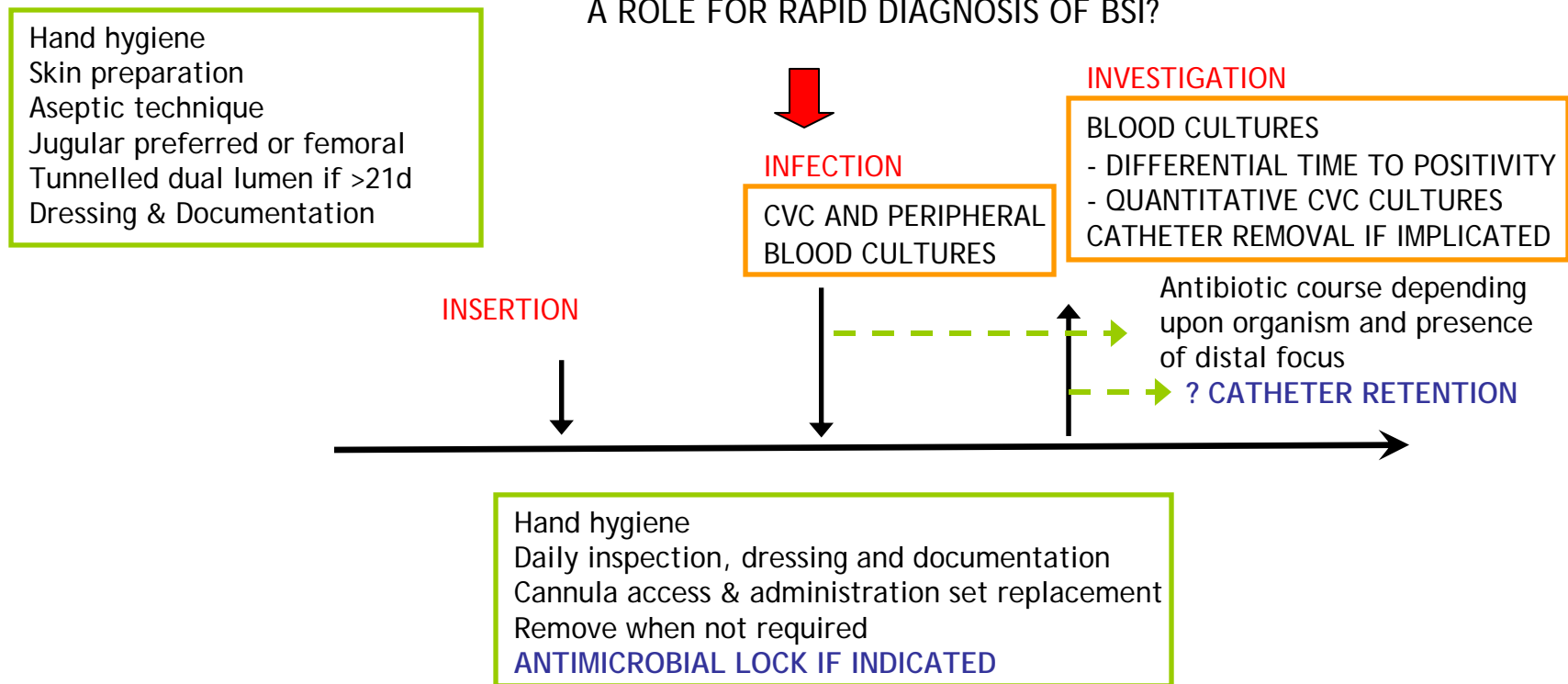
PREVENTION AND DIAGNOSIS OF CRBSI

SHORT TERM CENTRAL VENOUS CATHETERS (Catheter sparing)



BOARD TO FLOOR ACCOUNTABILITY, EDUCATION, SURVEILLANCE AND FEEDBACK

LONG TERM CENTRAL VENOUS CATHETERS - RENAL & ONCOLOGY (Catheter sparing)



ANTIMICROBIAL IMPREGNATED CATHETERS

Minocycline & Rifampicin impregnated catheters

	Setting	Bacteria MR	Controls	CRBSI/1000 CVC days (MR/controls)
Hanna (2004) n=365	Single centre oncology PICC Subclavian CVC	Gram -ve 2 Candida 1	CNS 5 <i>S. aureus</i> 5 Gram -ve 4 Candida 1	0.25 v 1.25 p=0.003
Leon (2004)* n=465	7 Intensive Care units Triple lumen CVC	CNS 1 Enterococcus 1 Gram -ve 2 Candida 1	CNS 7 Enterococcus 1 Gram -ve 2 Other 1	8.6 v 5.7 NS
Darouiche (1999)† n=865	12 hospitals (66% Intensive Care) Triple lumen	Enterococcus 1	CNS 8 Gram -ve 3 MRSA 1 VRE 1	0.3 v 4.1 p<0.001
Rello (1997) n=281	5 hospitals Triple lumen	0	CNS 6 Enterococcus 1	0 v 7.34 p<0.01

* Candida colonisation: MR v Controls n(%) 10/187(5.2) v 2/180 (1.1) RR 4.9: 95% CI 1.07 - 22.2

† Compares MR with chlorhexidine/silver sulphadiazine external impregnated catheters

Clinical effectiveness and cost-effectiveness of central venous catheters treated with anti-infective agents in preventing bloodstream infections: a systematic review and economic evaluation Hockenhull et al Health Technology Assessment 2008 vol 12 no 12

Casey et al Antimicrobial central venous catheters in adults: a systematic review and meta-analysis Lancet infectious diseases 2008 8:763-776

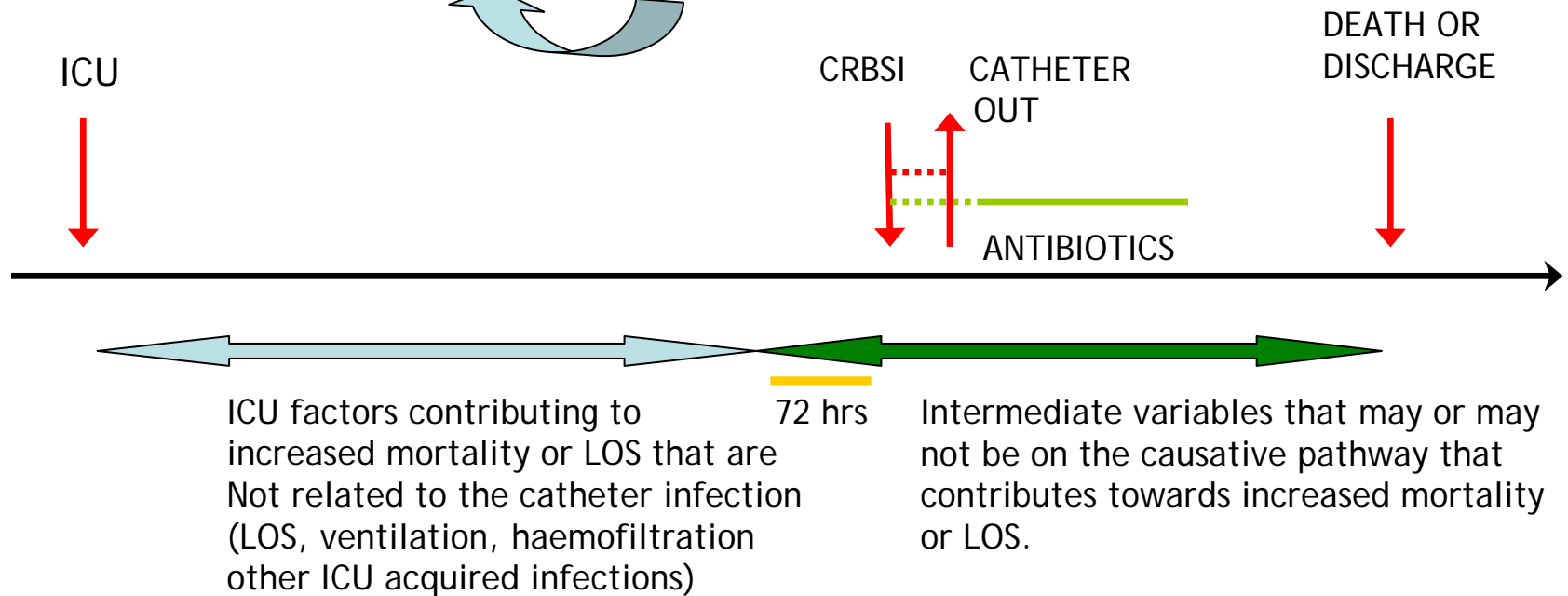
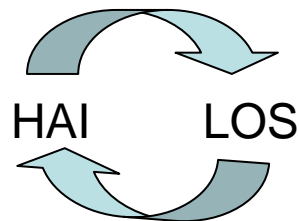
WHAT IS THE IMPACT OF CRBSI ON MORTALITY AND LENGTH OF STAY

	Bacteria (%)	Matching Cases/controls	Excess hospital length of stay	Mortality (%) Cases/controls
Soufir et al 1999 n=42	<i>S. aureus</i> 52 Gram -ve 41 Candida 3	SAPS score, McCabe values, length of catheterisation, Day 3 severity score	N/A	50/21 Adjustment for severity 1 week before CRBSI NS
Rello et al 2000 (n=49)	CNS 63 Gram -ve 22 Candida 2	APACHE, underlying disease, age ≥LOS prior to CRBSI,	20 days	22/35 NS
Renaud et al 2001 (n=61) Primary and CRBSI	CNS 23 <i>S. aureus</i> 13 Gram -ve 30	Age, location prior to ICU, admission category, SAPS II, Rapidly or ultimately fatal condition.	10 days (excess)	39/27 p= .3 CRBSI and I° bacteremia 44/24 p= .03
Blot et al 2005 (n=176)	CNS 41 Non-CNS 59 Gram -ve 26	APACHE II, Diagnosis ≥ LOS prior to CRBSI, short term CVC use	12 days	26/28 p= .871 29/25 p= .446 28/27 p= .999
Garrouste-Orgeas et al 2006 N=47 (185 other BSI)	CNS 36 Gram -ve 25 Candida 9	Three day recalibrated outcome score (incorporating SAPS II and LOD score) and LOS	N/A	CRBSI 42v39 NS I° 67v42 p<0.001

CNS - coagulase negative staphylococci

DEFINING THE IMPACT OF CRBSI

Admission Variables
 APACHE II
 LOS in hospital pre-admission



MODELLING THE IMPACT OF TIME DEPENDENT VARIABLES

	No of cases	Prolongation of LOS(mean +/- SE)	HR (95% CI)	P value
Pneumonia	158	6.2 +/- 2.5	45 (25-55)	<0.0001
Urinary tract infection	178	-1 +/- 3.3	1.06 (0.89-1.25)	0.52
Primary bloodstream	35	2.7 +/-6.0	0.75 (0.53-1.07)	.12
Surgical site	13	13.4 +/- 12.7	0.60 (0.33-1.09)	0.09

INSTITUTIONAL SURVEILLANCE AND DATA COLLECTION

- Care bundles (Saving lives)
 - Compliance with best practice as part of a care bundle
- Root cause analysis supporting mandatory reporting of MRSA bacteremia
- Clinical investigation of CRBSI (number or rate /1000 catheter days)

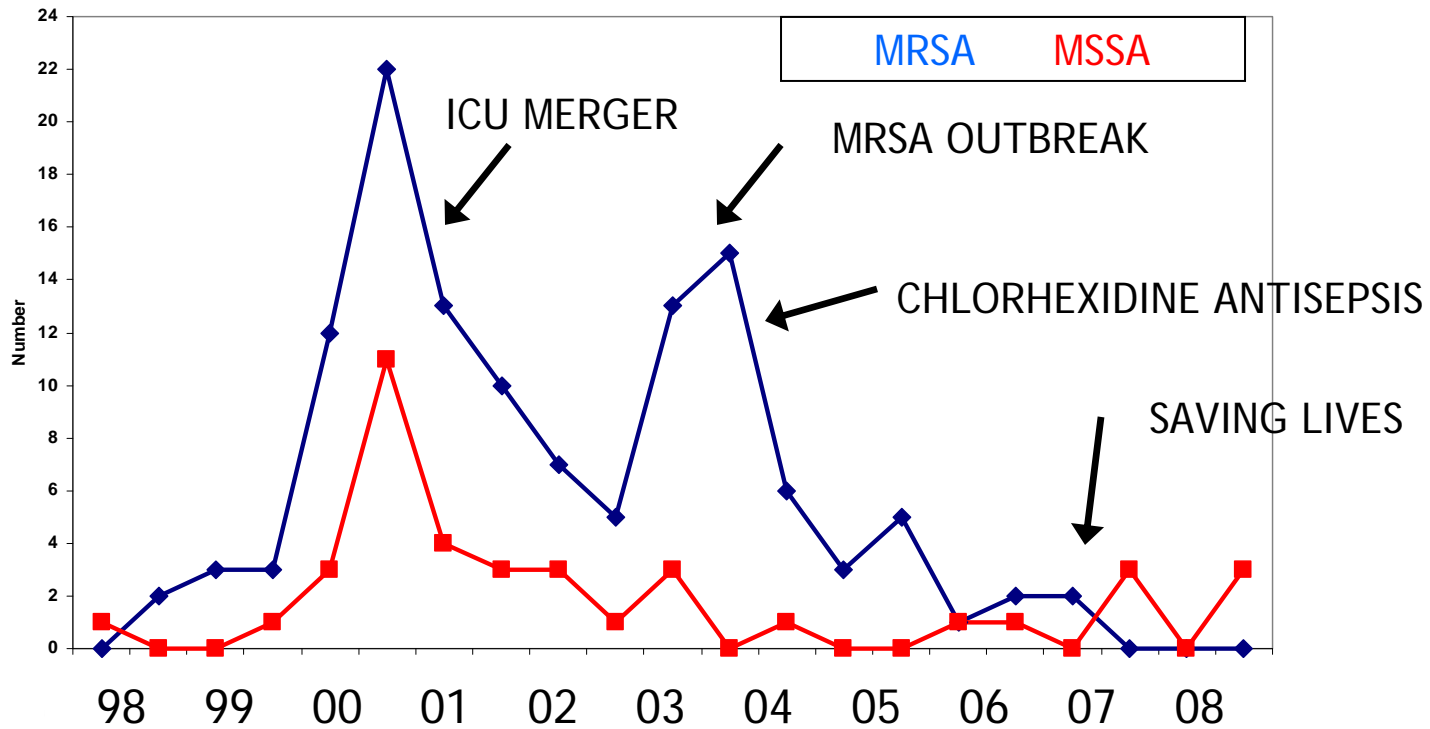
FOCUS OF MRSA BACTEREMIA

Enhanced surveillance of MRSA bacteremia
April 2001 - March 2003

	ICU/HDU (n=73)	Elsewhere (n=112)
CRBSI	50 (69)*	55 (49)
I ⁰ (NK)	18 (24)	42 (37)
II ⁰	5 (7)	16 (14)

* n(%)

S. aureus CRBSI IN CRITICAL CARE



Silver impregnated
 Chlorhexidine / silver sulphadiazine
 Non-impregnated arterial catheters

CONCLUSION

Comprehensive evidence based practical guidelines exist for prevention, diagnosis and management of CRBSI

Benefit of emerging new technologies must be assessed in the context of an effective existing institutional Infection Prevention and Control programme

Further analysis of the true burden of CRBSI is required to support economic analyses and ensure resources are targeted appropriately across the spectrum of healthcare-associated infections.